UNIVERSITI TEKNOLOGI MARA

ENHANCED PERFORMANCE OF ENCAPSULATED MULTI-ENZYME IN INDIGENOUS SAYONG CLAY FOR CASSAVA SACCHARIFICATION PROCESS

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

The encapsulation of multi-enzyme (alpha-amylase, glucoamylase and cellulase) within calcium alginate-clay beads was used in the saccharification of cassava into reducing sugar in a stirred tank bioreactor. The functional group, morphology and composition of beads were characterized by Fourier Transform Infrared Spectroscopy (FTIR) and Field Emission Scanning Electron Microscope (FESEM) equipped with Energy Dispersive X-ray Spectroscopy (EDX). The optimal encapsulation conditions of multi-enzyme in alginate-clay beads were obtained at 2 % (w/v) clay concentration and 0.2 M $CaCl_2$ solution which gave 97.34 % of loading efficiency and 53.71 % of immobilization yield. Kinetic parameters were determined for encapsulated multi-enzyme, as well as for the free multi-enzyme. The Michaelis constant, K_m value for encapsulated multi-enzyme (4.9176 mg/mL) was 1.39 times higher than free multi-enzyme (3.5367 mg/mL), whereas the maximum reaction velocity, V_{max} value was lower for the encapsulated multi-enzyme. Based on the one-factor-at-one-time (OFAT) study, the optimum pH, temperature and agitation speed for both free and encapsulated multi-enzyme were pH 6.0, 50 ^{o}C and 120 rpm, respectively. Furthermore, the optimum conditions for saccharification process were statistical determined using Response Surface Methodology (RSM). After screening significant factors that influence the saccharification process, pH, temperature and agitation speed were optimized by implementing central composite design (CCD) in RSM. The optimum values of pH, temperature and agitation speed were found to be pH 5.9, 44 ^{o}C and 94 rpm, respectively. Under these conditions, the experimental yield was 88.19 % which was close to the predicted yield (91.95 %). Meanwhile, encapsulated multi-enzyme was retained 15.09 % of its activity after 5 reaction cycles.

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